

Minnesota Perspective on PFAS

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Minnesota has a relatively long history of dealing with per- and polyfluoroalkyl substances (PFAS) in drinking water. Minnesota public water systems (PWSs) first monitored for and detected PFAS in 2004. The detection, risk evaluation, and treatment of PFAS at Minnesota PWSs will be reviewed. A discussion of challenges such as changing health-based values, lower detection limits, risk communication, and inter-agency collaboration will be included.

Topic

Background

Minnesota's PFAS Timeline

Health-Based Values

Response

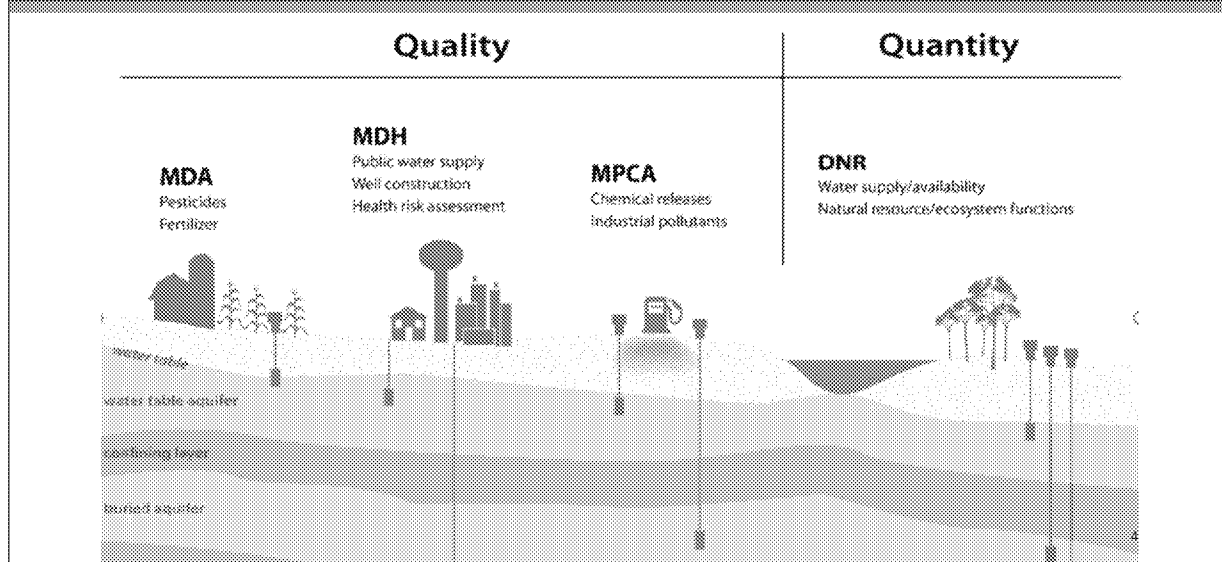
Lessons Learned

Minnesota Means Water



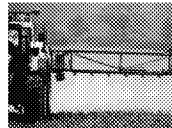
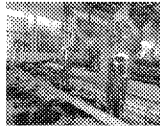
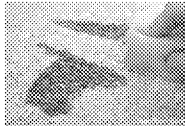
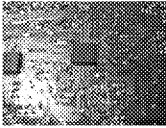
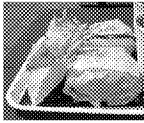
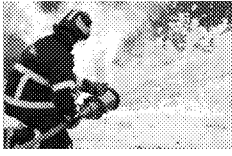
Minnesota has abundant natural water resources, but great responsibilities to preserve them, especially as a Headwaters State.

Minnesota Agency Water Roles



who is responsible for what related to water in MN

Per- and Polyfluoroalkyl Substances (PFAS)



- Family of many synthetic chemicals
- Developed and used since the 1940s
 - resist heat, stains, water, oil, grease
 - “non-stick”
- Production increased rapidly in the 1970s
- Persist in the environment, found everywhere

Source: open access images – bing.com

Per- and polyfluoroalkyl substances (PFAS) are chemicals developed and produced by companies like 3M since the 1940s.

They were used to make products like scotch-gard and Teflon.

They are VERY persistent in the environment, they do not break down.

PFAS are persistent in the environment

They don't break down and they can accumulate over time

PFAS can be found in

Food

Commercial household products

Workplaces

Living organisms

Drinking water

There is also increasing research on their potential risk to animals and humans.

Timeline of PFAS Activities in Minnesota

1950s – 1970s

- Disposal of PFAS occurred at sites in Washington County
- No regulations at time of disposal

2000

- 3M began phase-out of PFOA/PFOS products

2002

- 3M informed State of MN of detections of PFOA/PFOS in production wells in Washington County
- MDH releases first health-based guidance values

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From the 1950s through the early 1970s, 3M disposed of wastes from PFC manufacturing primarily in dump sites in Oakdale and Woodbury, at the 3M manufacturing facility in Cottage Grove, and at the Washington County landfill.

In the early 1960's, 3M and the U.S. Navy developed Class B "aqueous film forming foam" (AFFF) type foams. Class B foams are used on flammable petroleum fires and spills. Some or most Class B foams have had PFCs as part of their formulation, in particular PFOS.

Timeline of PFAS Activities in Minnesota

2002 – 2004

- Groundwater monitoring revealed PFOA/PFOS contamination at additional sites

2007

- MPCA and 3M agree to consent order

2010

- MN Attorney General files natural resource damage lawsuit on behalf of state

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Consent Order outlined that 3M is responsible for providing safe drinking water to affected residents, cleaning up PFAS waste disposal sites, and monitoring groundwater

We had looked in Bemidji earlier but didn't detect because of higher detection limits

Timeline of PFAS Activities in Minnesota

2014

- PFAS discovered at site in Bemidji, MN
- UCMR3 monitoring
- Source: firefighting foam (AFFF)

2018

- Settlement between 3M and State of Minnesota

2005 - present

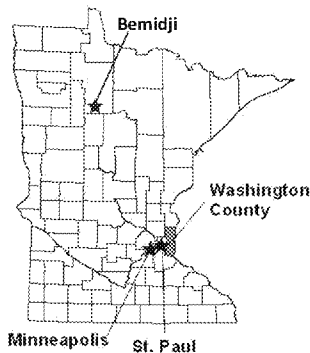
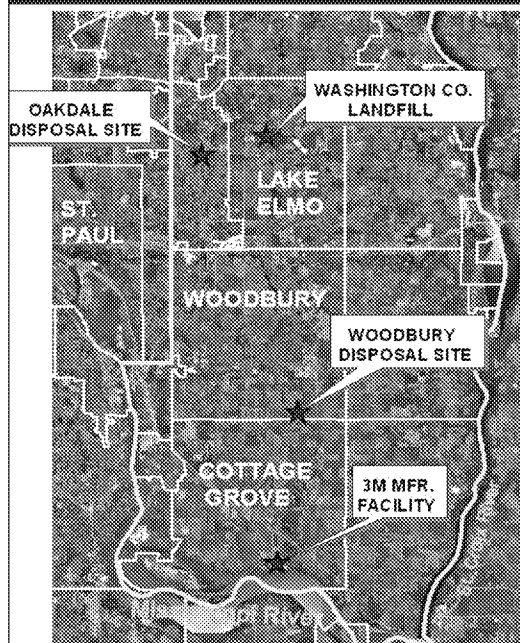
- Public water system monitoring and treatment
- Private well monitoring and treatment

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Consent Order outlined that 3M is responsible for providing safe drinking water to affected residents, cleaning up PFAS waste disposal sites, and monitoring groundwater

PFAS in Minnesota

LOCATION OF 3M SITES IN WASHINGTON CO., MINNESOTA



4 PFAS disposal sites in Washington County

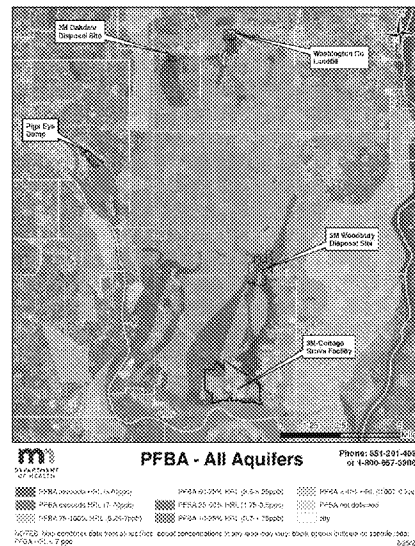
- 3M made PFAS at its Cottage Grove facility in the early 1950s
- PFOA was a primary product; some PFOS, PFBA and other PFAS

• Additional site in Bemidji

- Firefighting foam

Extremely Large “Co-Mingled” Plumes

- Over 130 sq. mi. in Washington County
 - 4 major aquifers
 - 8 municipal systems & >1,800 private wells
 - Much larger than predicted by models
- PFBA most widespread
 - More PFBA in source areas
 - More mobile
- Movement of PFAS affected by several factors



Distribution controlled by:

Bedrock features

Groundwater - Surface water interactions

PFAS chemical properties

Groundwater pumping

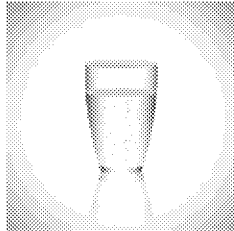
MDH Health-Based Guidance Values

PFOS:
0.027 ppb

PFOA:
0.035 ppb

PFBA:
7 ppb

PFBS:
2/3 ppb



- The concentration of a chemical (or a mixture of chemicals) that is likely to pose little or no risk to human health
- Based on potential health impacts; do not consider cost and technology of prevention and/or treatment
- Non-regulatory
- Protective for susceptible & highly exposed populations
- Protective for tap water used for drinking, cooking, showering, and other uses
- Based on animal studies showing slight liver and thyroid effects (adults) and immune system and developmental effects (infants/children)

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David – decide if you want to keep the breastfeeding info. This slide has a lot of info – I added animations to present bullet points one at a time. An alternative would be to remove some text and move to slide notes to present verbally only.

May be set at levels that are costly, challenging, or impossible for a water system to meet

PFBS:

2 = chronic

3 = subchronic

Breastfeeding can be a significant exposure pathway for PFHxS, PFOS, and PFOA.

However, breastfeeding is important for the short and long term health of both a mother and infant.

MDH recommends that women currently breastfeeding, and pregnant women who plan to breastfeed, continue to do so.

Health Risk Index

- MDH evaluates the combined effects of PFAS: Health Risk Index (HRI)
 - Allows us to account for differing levels of toxicity in similar chemicals
 - HRI > 1 indicates a possible health risk from given chemical group
- Cumulative – additivity assessment of chemicals with similar health endpoints (e.g. liver)

$$\frac{[\text{PFBA}]}{\text{PFBA HBG}} + \frac{[\text{PFBS}]}{\text{PFBS HBG}} + \frac{[\text{PFHxS}]}{\text{PFHxS HBG}^*} + \frac{[\text{PFOA}]}{\text{PFOA HBG}} + \frac{[\text{PFOS}]}{\text{PFOS HBG}} = \text{Health Risk Index}$$

where [PFAS] = detected PFAS drinking water concentration in HBG units

*Currently using PFOS as an interim substitute

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When did we start using HRI calculation?

4717.7870 EVALUATING CONCURRENT EXPOSURES TO MULTIPLE CHEMICALS.

RiskNext from multiple chemicals detected in groundwater must be evaluated as specified in part 4717.7880 for effects other than cancer and in part 4717.7890 for cancer. If a chemical causes both cancer and effects other than cancer, the PreviousriskNext contributed by that chemical must be included in both evaluations. When the multiple chemical PrevioushealthNext PreviousriskNext PreviousindexNext is greater than one, the multiple chemical PrevioushealthNext PreviousriskNext Previouslimit has been exceeded.

Statutory Authority:

MS s 103H.201

History:

33 SR 1792

Published Electronically:

May 11, 2009

4717.7880 MULTIPLE CHEMICAL HEALTH RISK LIMITS: NONCANCER.

Where did HRI formula come from? In MN rules?

The procedures stated in the Health Risk Limits (HRLs) Rules for Groundwater for evaluating exposure to multiple chemicals are based on an additive model. The U.S. Environmental Protection Agency (EPA) uses this model as a reasonable approach given what is unknown about how chemicals interact in the body. Chemicals that share a common health endpoint are evaluated together.

For each chemical sharing a health endpoint, a ratio is calculated by comparing the groundwater concentration of the chemical to the exposure duration-specific health-based guidance for that chemical. The ratios are grouped by duration and summed within each health endpoint group.

To determine whether the sum exceeds the multiple-chemical health index of one for noncancer, the chemicals are grouped according to their noncancer health endpoints, e.g., liver, kidney, nervous system.

Risk Assessment and Water Guidance

PFAS	Health Endpoints		PFOA	PFOS	PFBA	PFBS	PFHxS
<u>PFBA</u>	Liver and thyroid	2002	7	1			
<u>PFBS</u>	Developmental, female reproductive system, kidney, and thyroid [blood system & liver no longer listed]	2006	1	0.6	1		
		2007	0.5	0.3	7		
		2009	0.3	0.3	7	7	
<u>PFHxS</u>	(see PFOS)	2013	0.3	0.3	7	7	0.3
		2016	0.07	0.07	7	7	0.07
<u>PFOA</u>	Developmental, liver, immune system, and kidney	2017	0.035	0.027	7	3/2	0.027
<u>PFOS</u>	Developmental, liver, immune system, and thyroid	2018-19		under review			under review

More information can be found at: <http://www.health.state.mn.us/divs/eh/risk/guidance/gw/table.html>

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I'm not sure why certain words are underlined. And I'm not sure what the superscript 1 refers to.

Very active area of research. 50 – 80 publications in PubMed per month. MDH has revised guidance values 2 – 4 times as scientific knowledge changes.

Changing guidance values have presented a challenge. We have presented a moving target to PWSs. Challenge with changing science, as we learn more about these chemicals.

Guidance – all were re-evaluated in 2017 & all but PFBA were lowered due to new tox and/or expo information. Currently these are all HBVs, however, PFOA and PFBA are in a HRL rules revision effort and should be HRLs later this year. PFOS and PFBS will be taken through the next rules revision. PFHxS – may be in next rules revision, depending upon quality of data.

* - PFOS values used as a surrogate for PFHxS in evaluation of health risk from PFHxS ** - Good Cause Exception HRL

*** - HAs for PFOS and PFOA are additive (combined concentration should be < HA) ^ - UCMR3 data collected from 2013-2016 # - lower value reflects change in PHL reporting limits in late 2016 HBV - MDH Health Based Value HRL - MDH Health Risk Limit PHA - EPA Provisional Health Advisory HA - EPA Lifetime Health Advisory NA - not applicable, UCMR3 did not include PFBA

The PFOS and PFHxS health-based guidance values are currently under review due to new information.

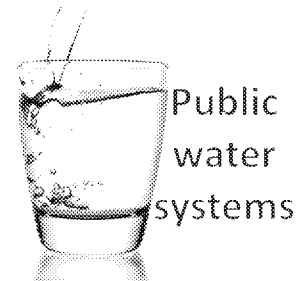
m1 DEPARTMENT
OF HEALTH

m1 MINNESOTA POLLUTION
CONTROL AGENCY

m1 DEPARTMENT OF
NATURAL RESOURCES

Washington County | MN
A great place to live, work, and play...today and tomorrow!

3M



MPCA and MN DNR are trustees for settlement funds, but many parties have a role.

The Minnesota Department of Health is responsible for drinking water monitoring, engineering assistance, health risk assessment, and site response.

The Minnesota Pollution Control Agency has the role of environmental protection, including Superfund site management, and was a party in the lawsuit against 3M.

The Minnesota Department of Natural Resources is responsible for protection of natural resources, including groundwater, and was a party in the lawsuit against 3M.

Washington County has...

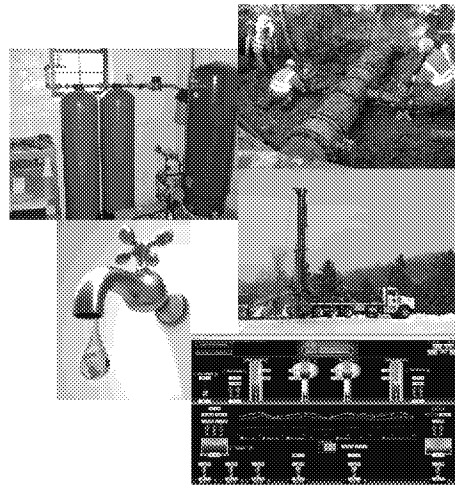
Public water systems and local governments have had to determine what actions, if any, to take to treat drinking water.

These entities have all collaborated on communicating with the general public, elected officials, and the media.

3M is the responsible party (not sure if we can say this since they did not admit wrongdoing?)

Response Options

- Regional interconnect
- New treatment facilities
- New wells
- Water conservation; limit use of contaminated wells
- Adapted blending scheme
- Others?

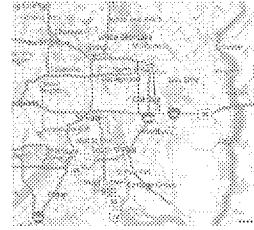


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Options systems have considered in response to PFAS. Will continue to be considered under settlement.

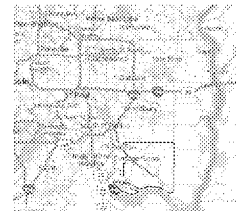
Oakdale (27,973)

- 9 wells; PFAS exceeds MDH health-based guidance value in 7 wells
- PFAS concentrations
 - highest in the state for community systems
 - PFOA: 0.440 ppb maximum
 - PFOS: 0.610 ppb maximum
- Treatment (GAC) installed in 2006 for 2 wells; carbon replaced annually
- Primarily rely on 2 treated wells and 2 “clean” wells for water supply
- Video: <http://bit.ly/2rWs9z5>



Cottage Grove (36,492)

- 12 wells; PFAS exceeds MDH health-based guidance in 8 wells
- PFAS concentrations
 - PFOA: 0.066 ppb maximum
- Impacted when health-based guidance values lowered
- Installed GAC treatment on 2 wells in 2017
- Directly blend 7 wells to manage concentrations
- Temporary watering ban in 2017 after receiving health advisory letter from MDH and prior to treatment



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Has 12 wells; 8 with PFAS exceeding MDH health-based guidance values

PFAS concentrations: no PFOS, 66 ppt PFOA

Impacted when health-based guidance values lowered

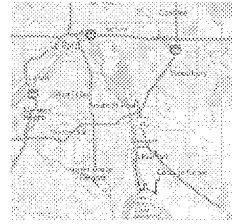
Installed GAC treatment on 2 wells in 2017

Have a direct blending point for 7 wells that can manage concentrations

Temporary watering ban in 2017 after receiving health advisory letter from MDH and prior to treatment

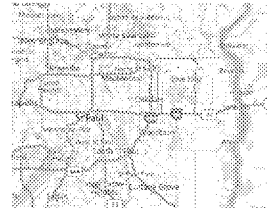
Saint Paul Park (5,519)

- 3 wells; PFAS exceeds MDH health-based guidance in 2 wells
- PFAS concentrations
 - PFOA: 0.043 ppb maximum
- Impacted when health-based guidance values lowered
- Want to install treatment on wells
- Managing pumping so clean well is used the most, and enforcing watering restrictions



Lake Elmo (4,878 / 8,069)

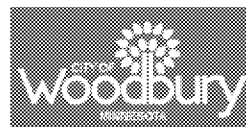
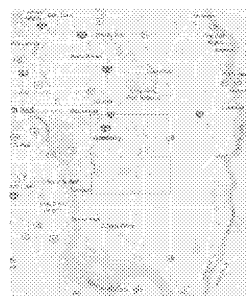
- Has 3 wells with 1 exceeding MDH health-based guidance values
- PFAS concentrations: no PFOS, 46 ppt PFOA
- Impacted when health-based guidance values lowered
- Many private wells in the city
- Options for new well limited by water quantity issues



Options for new well limited by White Bear Lake water level situation (5 mile radius)

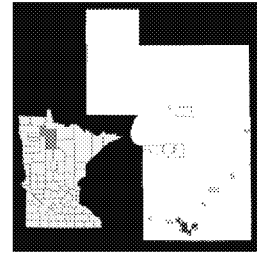
Woodbury (69,245)

- 19 wells; PFAS exceeds MDH health-based guidance values in 5 wells
- PFAS concentrations
 - PFBA: 0.41 ppb maximum (all wells)
 - PFHxS: 0.07 ppb maximum (1 well)
 - PFOA: 0.049 ppb maximum (8 wells)
 - PFOS: 0.026 ppb maximum (3 wells)
- Primarily rely on wells that meet MDH health-based values for water supply. Others are used only seasonally to meet peak demand.



Bemidji (14,942)

- 5 wells; PFAS exceeds MDH health-based guidance values in 4 wells
- PFAS concentrations
 - PFOS: 0.37 ppb maximum
 - PFHxS: 0.57 ppb maximum
- Source: firefighting foam – city responsible party
- PFAS discovered through UCMR3 monitoring
- All affected wells within city's airport and go to combined discharge – currently using 2 by blending
- Evaluating options – wells, treatment, new well field



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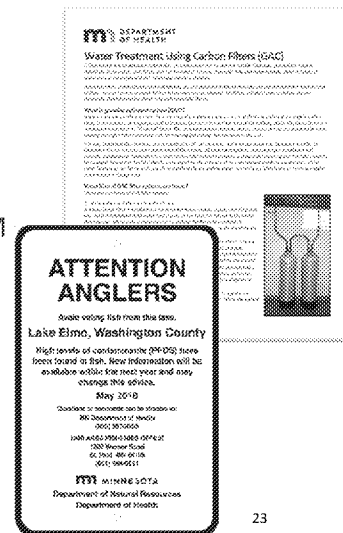
Bemidji is different from the other sites – PFAS from firefighting foam use.



Community perspective

Other PFAS Activities

- Private well sampling
 - >1,500 private wells sampled since 2003
 - >800 drinking water advisories issued
 - Homeowners provided in-home treatment funded by 3M
- Water filtration testing
 - GAC, RO, POU
- Fish consumption advice
 - Recommendations on how often to eat fish from certain waters



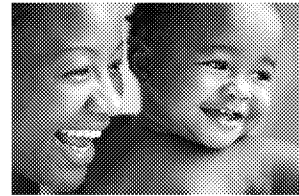
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Not sure about 2,500 number – website says 1,400 sampled:

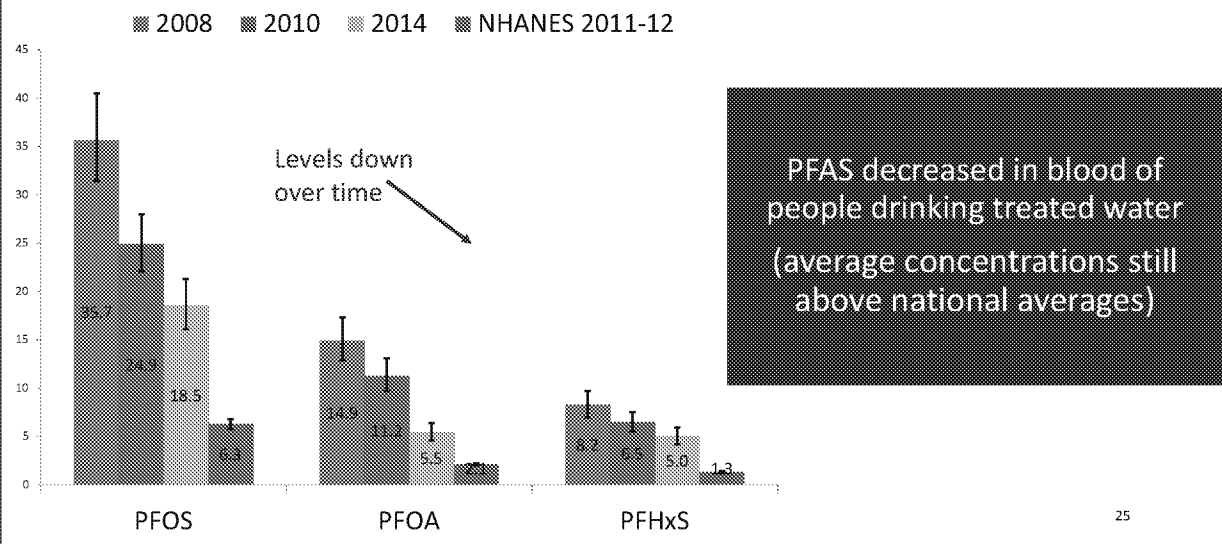
<http://www.health.state.mn.us/divs/eh/hazardous/topics/pfcs/index.html#responseaffected>

Other PFAS Activities

- PFAS in Homes and Gardens study (2010)
 - Tested water, soil, produce and dust at 20 homes with PFAS in water
 - PFBA found in 98% of produce
 - No health risks of concern when considering all exposures
- Biomonitoring
 - Measured blood levels of 8 PFAS chemicals in two groups of East Metro residents
 - Levels were highest in those who lived longest in the area before treatment was installed



Biomonitoring During Response



2018 Minnesota 3M PFC Settlement

- \$850 million grant to the state
- Trustees: Minnesota Pollution Control Agency and Minnesota Department of Natural Resources
- \$720 million to provide long-term solutions for:
 - Clean and sustainable drinking water
 - Restoration and enhancement of natural resources
- Expectations for community participation
- Preserves 3M's obligations under the 2007 consent order



More information can be found at <https://3msettlement.state.mn.us>

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MDH was not part of the lawsuit (because it was about natural resource damages), so we are not a trustee of the funds

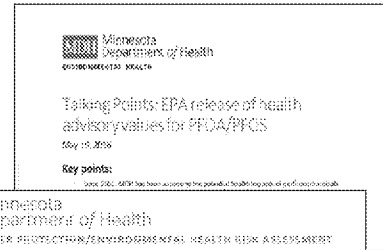
Lessons Learned

- Lack of federal maximum contaminant limit (MCL) means state has to decide how to act and regulate
- Collaboration is important
 - Different parties may have different priorities
- Politics can quickly change a timeline



Lessons Learned

- Communication is key
 - Must include the public, regulators, regulated parties, and elected officials
 - Not an emergency; PFAS health effects are based on a lifetime of exposure
 - State government regulators must give cities time to prepare a response
 - Unique risk communication challenges



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Collaboration is key

But different parties may have different priorities

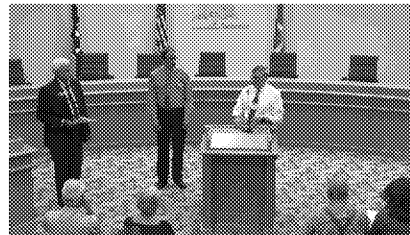
Communication is key

Must include the public, regulators and those regulated, and elected officials

Not an emergency; PFAS health effects are based on a lifetime of exposure

State government regulators must give cities time to prepare a response

- Will continue to see changing health-based guidance values
- Will see broader analytical methods
 - Will be able to detect more PFAS chemicals (e.g. GenX)
- How to spend \$720 million
 - Open houses and working groups to identify potential projects
 - Politicians and local municipalities may have “pet projects” they would like included – open checkbook mentality



Will see broader analytical methods

Now: Get ~7 PFAS in current MDH analytical method

Going forward will likely see more, so we will detect more (e.g. GenX in NC)

Photo from July 2018 PFAS public meeting in the city of Oakdale



Safe drinking
water for
everyone,
everywhere
in Minnesota

Questions?

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